

BROOD HABITAT USE BY SAGE GROUSE IN OREGON

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ABSTRACT.—Habitat use by Sage Grouse (*Centrocercus urophasianus*) hens with broods was examined at Jackass Creek and Hart Mountain, Oregon, from 1989 through 1991. Sage Grouse hens initially selected low sagebrush (*Artemisia* spp.) cover types during early brood-rearing, big sagebrush cover types later in the brood-rearing period, and ultimately concentrated use in and near lakebeds and meadows. Areas used by Sage Grouse broods typically had greater forb frequency than did random sites. Hens at Jackass Creek selected sites with forb cover similar to that generally available to broods at Hart Mountain, but home ranges were larger at Jackass Creek because of lower availability of suitable brood-rearing habitat. Differences in habitat use by broods on the two areas were reflected in dietary differences; at Hart Mountain, chicks primarily ate forbs and insects, whereas at Jackass Creek most of the diet was sagebrush. Larger home ranges, differences in diets, and differences in availability of forb-rich habitats possibly were related to differences in abundance and productivity between areas.

Key words: broods, *Centrocercus urophasianus*, habitat, Oregon, Sage Grouse.

Habitat factors, including resource availability, may limit Sage Grouse (*Centrocercus urophasianus*) populations through reduced recruitment of young (Klebenow 1969, Blake 1970, Wallestad 1975, Autenrieth 1981). Stand structure and food availability are characteristics most frequently associated with habitat selection by hens with broods (Klebenow 1969, Peterson 1970, Wallestad 1971, Autenrieth 1981). Dunn and Braun (1986) found that vegetative cover and extent of habitat interspersation are the most important factors influencing summer habitat use by Sage Grouse. Forbs and insects typically constitute the primary food of chicks (Klebenow and Gray 1968, Peterson 1970, Drut et al. 1994), and forb cover is often greater at sites used by broods than at random locations (Klebenow 1969, Autenrieth 1981, Dunn and Braun 1986). Shrubs, particularly sagebrush (*Artemisia* spp.), provide escape and thermal cover (Klebenow and Gray 1968) but are not a primary component of chick diets except where forbs and insects are limited in availability (Drut et al. 1994). Peterson (1970) noted decreased use of sagebrush/grassland cover types as broods mature and ascribed these changes to differential availability of succulent forbs. Martin (1970) observed that broods typically use big sagebrush

(*A. tridentata*) stands during early brood-rearing and that broods <6 weeks old use areas with lower densities of sagebrush than do older broods.

Despite numerous studies of Sage Grouse summer habitat use, knowledge of habitat use and selection by Sage Grouse hens with broods is incomplete because of small sample sizes, lack of information about use and availability of cover types and habitat components within cover types used by hens with broods, failure to distinguish habitat use by hens with broods from other adults, or no provision of information regarding population status and habitat use. Information that relates population status and habitat use is critical for Oregon because the western subspecies (*C. u. phaios*), which inhabits most of the Sage Grouse range in the state, was listed as a candidate for threatened and endangered status by the Department of Interior in 1985. This listing resulted from declines in abundance caused by depressed productivity (Crawford and Lutz 1985). The objective of the study was to determine use of cover types and habitat components by Sage Grouse hens with broods during two brood-rearing periods on two study areas with different Sage Grouse population characteristics in southeastern Oregon.

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STUDY AREAS

The study was conducted at Jackass Creek, administered by the Bureau of Land Management, and Hart Mountain National Antelope Refuge, administered by the U.S. Fish and Wildlife Service. Estimates of Sage Grouse abundance since 1980 indicated approximately 2.5 birds/km² and 1.5 birds/km² at Hart Mountain and Jackass Creek, respectively (J. Lemos, Oregon Department of Fish and Wildlife, unpublished data; W. H. Pyle, U.S. Fish and Wildlife Service, unpublished data). Summer productivity counts from 1985 through 1992, the only period for which comparable data were available, averaged 1.6 and 0.9 chicks/hen ($p < .05$) at Hart Mountain and Jackass Creek, respectively.

The Jackass Creek study area, approximately 70 km southwest of Burns, Harney County, Oregon, comprises nearly 39,000 ha. Prominent shrubs are low sagebrush (*A. arbuscula*) and big sagebrush (*A. tridentata*). Western junipers (*Juniperus occidentalis*) are present on the eastern portion of the study area. Common annual and perennial forbs include mountain dandelion (*Agoseris* spp.), hawksbeard (*Crepis* spp.), lupine (*Lupinus* spp.), and phlox (*Phlox* spp.). Grasses are principally bluegrass (*Poa* spp.) and fescue (*Festuca* spp.). Annual temperature averages 10°C, and mean precipitation is 25 cm.

The Hart Mountain National Antelope Refuge study area is 100 km southwest of Jackass Creek in Lake County, Oregon, and is 89,000 ha in size. Dominant cover consists of low sagebrush, big sagebrush, and antelope bitterbrush (*Purshia tridentata*). Areas >2000 m in elevation contain curl-leaf mountain-mahogany (*Cercocarpus ledifolius*) and trembling aspen (*Populus tremuloides*). Forb and grass composition is similar to Jackass Creek. At refuge headquarters (elevation 1700 m) annual temperature averages 6°C, and mean precipitation is 29 cm. Plant nomenclature follows Hitchcock and Cronquist (1987).

METHODS

Sage Grouse hens were radio-marked in 1989–91 (Gregg et al. 1994). At the conclusion of each field season, marked hens were recaptured, radio transmitters were removed, and a sample of previously unmarked hens was equipped with radios to maintain indepen-

dence of samples among years. Radios were attached with herculite ponchos (Amstrup 1980), and all hens were fitted with numbered leg bands. Locations of radio-marked hens were obtained with portable receivers and two-element, hand-held antennae.

Cover types and habitat components used for rearing broods were identified from locations of radio-marked hens with broods. Radio-marked hens with broods were located four times weekly to identify cover types used. Monitoring of broods continued until a hen lost her brood or brood integrity disintegrated (approximately 1 August each year).

We classified cover at brood sites into one of seven cover types: big sagebrush, low sagebrush, mixed sagebrush, lakebed/meadow, mountain shrub, grassland, and juniper/aspen. Cover type descriptions were based on Soil Conservation Service information (J. Kinzel, U.S. Department of Agriculture, Soil Conservation Service, unpublished data) and previous descriptions at Jackass Creek (Trainer et al. 1983, Gregg 1992).

Study area boundaries, based on locations of radio-marked hens with broods, were determined each year with the minimum convex polygon method (Mohr 1947, Odum and Kuenzler 1955). Proportions of cover types within the area used for rearing broods were determined with a dot grid system (Avery 1977).

Each brood location was marked and served as a site for habitat sampling, which was completed within 2 days after location of a brood. Percent cover of forbs, grasses, and shrubs and frequency of occurrence of ground-dwelling insects were measured at all brood locations. We established two 10-m perpendicular transects intersecting at each brood location. The position of the first transect was determined from a randomly selected compass bearing. The intercept distance (cm) of all species of shrubs along each transect was recorded to determine canopy cover (Canfield 1941). Heights of shrubs intercepted were measured from the ground to the top of the shrub canopy and placed into one of three classes: short (<40 cm), medium (40–80 cm), or tall (>80 cm). Canopy cover of shrubs was recorded separately for each height class. Percent cover of forbs was estimated from five uniformly spaced rectangular plots (20 × 50 cm) on each transect (Daubenmire 1959).

Sampling intensity was determined by constructing a species area curve with data collected from initial sampling (Pieper 1978:12). Occurrence of ground-dwelling arthropods was established from 12 pitfall traps (Morill 1975) arranged systematically along each 23-m transect, 36 at Hart Mountain and 28 at Jackass Creek, in cover types used by broods (see Drut et al. 1994). Arthropods were classified into Scarabeidae (June beetles), Tenebrionidae (darkling beetles), Formicidae (ants), and other.

Vegetative structure of habitats available to Sage Grouse broods was characterized at randomly selected locations within cover types on each study area during the brood-rearing period. Sampling of random locations, which was concurrent with measurements taken at sites used by broods, was conducted during May and June of each year. Number of random locations sampled in each cover type was based on canopy cover of sagebrush, which represented the least variable habitat component, and was determined with the "n-test" (Snedecor and Cochran 1980:210).

Home ranges for hens with broods were determined with the McPaal home range program (Stuwe and Blohowiak 1983). Home ranges were compared for two brood-rearing periods (early: hatching to 6 weeks; and late: 7 to 12 weeks after hatching) within and between study areas with chi-square analysis (Snedecor and Cochran 1980:20). Six-week intervals were based on data from Martin (1970), which indicated hens with broods changed habitat use at this time, and from Peterson (1970), which revealed differences in foods consumed by juveniles beginning approximately 6 weeks after hatching.

Within study areas, cover types used by Sage Grouse for rearing broods were compared with availability of cover types. Between study areas, cover type availability and use were compared. We arranged data in contingency tables and analyzed them with chi-square analysis; cover types with <5 brood locations were combined and analyzed collectively. If differences were detected, confidence interval testing (Neu et al. 1974, Byers et al. 1984) was used to identify cover types used selectively. Use of cover types by hens with broods of different ages was compared with chi-square to assess possible changes in habitat use associated with age of broods. Cover types used for nesting by hens that successfully hatched clutches were compared with cover types used by hens with broods during the first 6 weeks after hatching.

Habitat components measured at brood sites were compared by chi-square analysis to random sites within the same cover types for each study area to identify which vegetative components were selected. Analysis of variance was used to test among cover types and between study areas for differences in availability (random locations) and use (brood locations) of vegetative cover (Snedecor and Cochran 1980:258). The least significant difference test was used to separate means (Snedecor and Cochran 1980:272). Results were considered significant at the 95% level.

RESULTS

Most broods (13) were produced in the big sagebrush cover type, but during early brood-rearing (hatching–6 weeks), hens with broods were most frequently found (54–67% of

TABLE 1. Use and availability of cover types in which Sage Grouse broods were produced and those used for early (hatching–6 weeks) and late (7–12 weeks) brood-rearing periods at Jackass Creek and Hart Mountain, Oregon, 1989–91.

Cover type	Jackass Creek					Hart Mountain				
	Used (% frequency)			Available (% of area)		Used (% frequency)			Available (% of area)	
	Hatched (N = 7)	Early (N = 7/84) ^a	Late (N = 3/40) ^a	Early	Late	Hatched (N = 11)	Early (N = 11/89) ^a	Late (N = 4/40) ^a	Early	Late
Big sagebrush	42	17	45	54	30	91	32	52	30	57
Low sagebrush	29	53	17	32	30	9	67	38	48	16
Mixed sagebrush	29	29	20	9	15	0	0	0	1	1
Lakebed/ meadow	0	0	15	3	23	0	0	8	3	5
Other	0	0	3	2	2	0	1	2	18	21

^aNumber of broods/number of locations.

observations) in low sagebrush cover (Table 1). Three cover types were used differentially during early brood-rearing: low sagebrush was used more ($p < .05$) than expected on both areas, mixed sagebrush was used in greater proportion ($p < .05$) than available at Jackass Creek, and big sagebrush was used to a lesser extent ($p < .05$) than available at Jackass Creek. None of the other cover types was used during the early brood-rearing period.

During late brood-rearing (7–12 weeks) habitat use shifted to predominantly big sagebrush (45–52% of observations). Use of low sagebrush declined on both areas (Table 1). Availability of low sagebrush within areas used by hens with broods declined from 48 to 16% at Hart Mountain as hens with broods moved away from low-sagebrush-dominated areas. Also, during late brood-rearing, use of lakebeds and meadows increased; these habitats received the greatest use after brood break-up in August.

Forb cover ranged from 10 to 14% at sites used by hens with broods during the early brood-rearing period (Table 2) and was greater ($p < .01$) at sites used by broods than at random locations at Jackass Creek. At Hart Mountain, forb cover was used in proportion to availability during early brood-rearing (Tables 2, 3). During late brood-rearing, forbs were used in greater ($p < .01$) proportion than available at Hart Mountain, where sites used by broods had 19–27% forb cover. No use pattern in relation to forb availability was evident at Jackass Creek during late brood-rearing. There were no differences in use and availability for any shrub cover category in low ($p > .50$), big ($p > .20$), or mixed ($p > .20$) sagebrush stands. Only in lakebed/meadow habitat at Jackass Creek during the late brood-rearing period were use and availability of shrub cover different ($p = .05$). In that instance, cover of short and medium shrubs was approximately twice as great at sites used by broods as at random locations (Tables 2, 3).

Hart Mountain had more forb cover ($p < .05$) and less tall shrub cover ($p < .05$) than Jackass Creek (Table 3). In addition, there was more ($p < .05$) short shrub cover available during the early brood-rearing period at Jackass Creek than at Hart Mountain. The greatest availability of forb cover on both areas was in lakebed/meadow habitat during late-brood-rearing (14 and 21% at Jackass Creek and Hart

Mountain, respectively). Hart Mountain supported greater ($p < .01$) frequencies of ground-dwelling arthropods than did Jackass Creek, but no differences were found within study areas between time periods or cover types except at Jackass Creek, where mixed sagebrush had a greater ($p = .05$) frequency of invertebrates during the early period than did low sagebrush (Table 4).

At Hart Mountain, big sagebrush and lakebed/meadow habitats supported more ($p < .05$) forbs than did low sagebrush during late brood-rearing (Table 3). At Jackass Creek low and big sagebrush supported the same cover of forbs (6%) during late brood-rearing, but the lakebed/meadow habitat had greater ($p < .05$) forb cover (14%). There was more ($p < .05$) cover of medium and tall shrubs in big sagebrush stands compared with low sagebrush (Table 3).

Mean home range sizes at Hart Mountain, were 800 and 100 ha for the early and late periods, respectively, whereas at Jackass Creek mean home ranges were 2100 and 5100 ha, respectively. Home range size was smaller ($p = .02$) in the late period than the early period at Hart Mountain, whereas home range size increased ($p < .01$) during the late period at Jackass Creek. Home range size was smaller ($p < .01$) at Hart Mountain than at Jackass Creek during both periods.

DISCUSSION

Sage Grouse hens with broods displayed similar use of cover types on the two study areas. The change in cover-type use of successfully nesting hens from big sagebrush to low sagebrush during the first 6 weeks after hatching was unique to this study. Perhaps availability of foods partially accounted for this change in use of cover types. Klebenow (1969), Peterson (1970), Wallestad (1971), Autenrieth (1981), and Dunn and Braun (1986) reported relationships between habitat use by broods and food availability. Return to use of big sagebrush during weeks 7–12 after hatching was similar to findings elsewhere. Canopy cover and shrub height at brood sites in Montana changed from 6% and a range of 15–30 cm, respectively, in June to 12% and 30–45 cm in August (Peterson 1970). Pyrah (1971) and Wallestad (1971) noted sagebrush height was greater in cover types used by broods during

TABLE 4. Frequencies of occurrence (%) of major insect groups available during early (hatching-6 weeks) and late (7-12 weeks) Sage Grouse brood-rearing periods at Jackass Creek and Hart Mountain, Oregon, 1989-91.

Family	Low sagebrush				Big sagebrush			Mixed sagebrush	
	Jackass Creek		Hart Mountain		Jackass Creek	Hart Mountain		Jackass Creek	
	Early (N = 102)	Late (N = 84)	Early (N = 120)	Late (N = 36)	Early (N = 12)	Early (N = 60)	Late (N = 36)	Early (N = 60)	Late (N = 60)
Scarabidae	1	0	10	14	0	4	9	0	0
Tenebrionidae	11	8	17	14	28	16	27	15	12
Formicidae	42	47	68	62	42	81	76	61	41
Other	49	38	70	74	37	97	96	52	51

late summer; sagebrush canopy cover used by hens with broods changed from 14% in June to 21% in September (Pyrah 1971).

Cover types used by hens with broods typically had greater availability of forbs during periods of high use, but differences in availability between areas influenced use of cover types, movements, and diets. Hens at Jackass Creek selectively used sites with forb cover greater than typically found there and similar to that generally available to broods at Hart Mountain. This amount of forb cover (12-14%) may represent the minimum needed for brood habitat in Oregon. The lack of a relationship between brood use and forb availability during the late brood-rearing period at Jackass Creek likely was related to the dietary shift by chicks to sagebrush during this time (Drut et al. 1994).

Home ranges of hens with broods were larger at Jackass Creek than at Hart Mountain and increased over time. May and Poley (1969) observed no movements from meadows until fall in Colorado, and in Montana brood home ranges decreased from 85 ha in June to 51 ha in August (Wallestad 1971). The large home ranges at Jackass Creek reflected differences in forb availability and chick diets between areas (Drut et al. 1994). Chicks consumed primarily forbs and insects at Hart Mountain but ate mostly sagebrush at Jackass Creek (Drut et al. 1994). Home ranges in Idaho were larger for hens with broods than for broodless hens (406 ha and 174 ha, respectively), which possibly was related to forb use (Connelly and Markham 1983). These authors also noted that Sage Grouse may occupy larger summer home ranges in wet years because of greater availability of forbs. Differences in availability of brood-rearing habitats, dietary intake of chicks, and home range sizes perhaps are related to differences in productivity and

abundance of Sage Grouse at the two study areas.

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